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AGRICULTURAL Research

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MORE EFFICIENT WATER USE

AGRICULTURAL
Research

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Contents

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Expectations

Looking to the future can sometimes be pleasant; at other times, alarming. Consider the impact of our rapidly expanding population on one group of products, red meats.

It might very well be that we will want to consume some two-thirds more red meat in 1980 than we are eating now. In terms of livestock, this would be about 28 million more hogs and about 60 million more cattle.

Our farmers can meet rapidly increasing demands for livestock and livestock products with a steady increase in livestock numbers. But there's a rub: as we build up numbers we also build up opportunities for animal diseases and pests.

Some changes in livestock production can already be observed. Bigger herds, closer confinement, and greater concentration at production and marketing centers increase chances of serious disease and pest outbreaks. Breeding stock is of higher quality. Investments are larger. The future demands more intelligence in management, less trusting to chance. More specialized knowledge of disease and pests in production is needed now than when we worked with smaller units.

Owners will be increasingly concerned with disease prevention because they see the dollar value of preventing outbreaks. They prefer the cost of prevention to the higher cost of dealing with trouble after it starts. Economic pressures for sound livestock health programs will be great.

We can look at the past to help us plan for the future. We've been successful in meeting threats of diseases and pests through adoption of sensible, realistic policies. First, we believe it is better to keep out diseases and pests than it is to live with them. Second, in dealing with established diseases and pests, eradication is best, if possible. Control or limitation is essential.

These policies must be continued and strengthened. Also, we will need more highly developed skills in our husbandmen, veterinarians, inspectors, and scientists.

Recognizing increased future demands for livestock products, we must have progressive research and regulatory programs that will help us discharge our responsibilities.

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AGRICULTURAL RESEARCH SERVICE
United States Department of Agriculture

Insect-damaged control cotton is examined by entomologists Lukefahr (left) and Martin.

Experimental cotton, checked by geneticist Rhyne, seems nearly free of pest injury.

In attempts to save plants, scientists are developing . . .

COTTONS THAT STARVE INSECTS

Some pests may stay out of fields because the supply of nectar is being greatly reduced in new selections

■ We're trying to starve some costly insects out of cotton fields by taking away most of the nectar they relish as food.

Promising upland cotton selections that will produce floral nectar *only*—and just on those days when flowers bloom—are being developed by USDA scientists. When the floral nectar is gone, the insects will have to seek their meals elsewhere. Hope is that the pests will not return to lay eggs which hatch into voracious larvae on cotton plants.

Upland cottons also secrete extrafloral nectar in varying amounts through leaves and bracts (leaves on flowers). This nectar comes from nectaries—glandlike organs—usually found on the midrib on the lower side of each leaf and below, between, and inside the bracts.

Extrafloral nectar is secreted from spring until fall frost kills the plants. Insects such as the cotton leafworm, cabbage looper, pink bollworm, common bollworm, and boll weevil are attracted all season.

A comparison of Empire, a popular variety, with one of the new (nectaryless or nectariless) selections showed that there were 7 to 10 times as many leafworms and loopers on the Empire as on the nectaryless cotton. In another test, there were twice as many pink bollworms on Empire as on the nectaryless selection. Equal numbers of these adult insects (moths) were put in each cage containing the same number of flowering cotton plants. Larvae, then pupae were counted to estimate how many moths might emerge for the next generation.

TURN PAGE

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Chiefly responsible for the research are geneticists C. L. Rhyne and J. R. Meyer, and entomologists M. L. Lukefahr and D. F. Martin, all of ARS. Cooperating are the Mississippi, North Carolina, and Texas Agricultural Experiment Stations.

What effect the new cottons will have under field conditions is not yet known. Maybe strong-flying moths will feed on nectar secreted by other flowering plants and return to cotton fields to lay eggs. But perhaps the moths will stay near food on other flowering plants and won't be attracted to the cotton.

It's possible that many moths will die in midsummer because of the lack of flowering plants other than cotton. And these other plants might not produce any or enough extrafloral nectar to sustain moths. Cotton is the primary plant that flowers in midsummer at Brownsville, Tex., where some of the studies are conducted.

Must control other pests to maintain advantage

Insects such as the cotton aphid or mealy bug, which deposit honeydew on cotton plants, must be controlled by conventional methods to maintain any advantage from the new cottons. Honeydew is readily eaten by the very destructive leafworm moth when nectar is not available. This was shown in one test cage at Brownsville, when a mealy bug population developed and secreted enough honeydew to keep leafworms alive. Other insects also might eat honeydew.

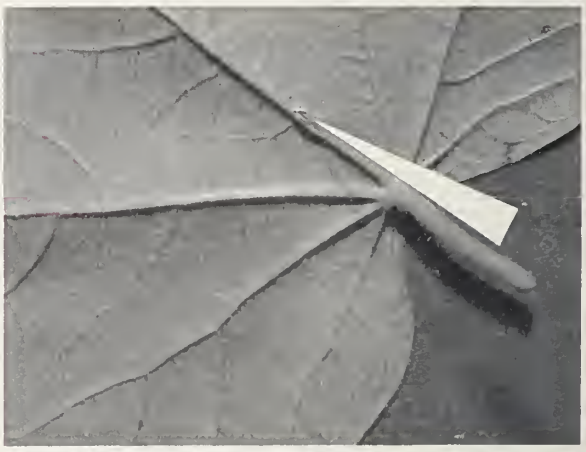
One of the experimental cottons has *no* extrafloral nectaries. A second has nectaries on the leaves only, and a third has only an occasional leaf nectary which usually doesn't function. Bract nectaries are absent from all of these new types.

Disadvantages of the first nectaryless cottons were bolls much smaller than those of commercial cottons and unsatisfactory fiber properties. However, these characters have been largely improved in the latest experimental cotton which has boll size and staple length nearly equal to popular upland varieties. As research continues, the scientists believe they can develop nectaryless upland cottons not attractive to insects but with the boll size and fiber properties desired by growers and industry.

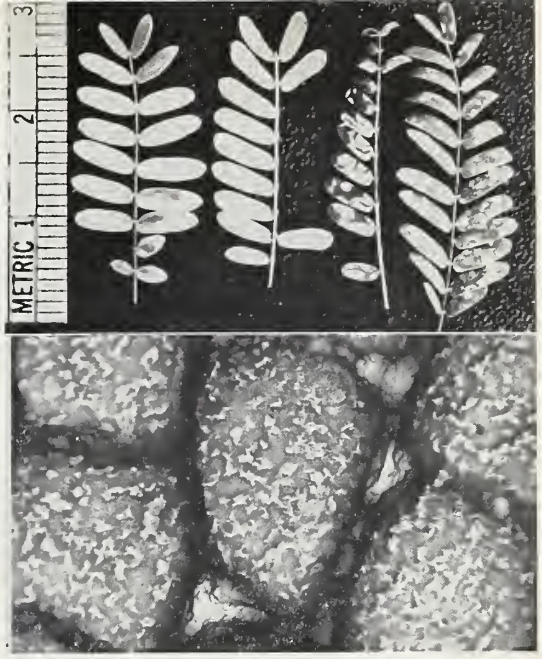
The nectaryless characteristic was found in *Gossypium tomentosum* N., a wild Hawaiian cotton species. This characteristic is being transferred into upland cotton, *G. hirsutum* L., by a breeding program of alternate backcrossing and selfing. ☆

Pointer indicates position of inner bract nectary on upland cotton. All bract nectaries, inner and outer, have been bred out of experimental cotton.

Three indentations are outer bract nectaries on a variety of upland cotton. These and nectaries on leaves are food sources for several insect pests.



There are no leaf nectaries, shown by pointer, on one of the new cottons. Another selection has an occasional, usually nonfunctioning, leaf nectary.



Almost-dead leaflets (top) at left received spray of sodium salt of 2,4,5-T 3½ weeks before photo was taken. Leaflets at right were sprayed with pentachlorophenol 11 weeks before; only contacted tissue is dead. In electron micrograph (bottom) note minute wax extrusions on cell surface and globular extrusions along intercellular areas of epidermal cells in lower surface of leaf.

The Search for Better

Mesquite Controls

Electron microscopy may show why chemical control isn't effective year after year

■ The Southwest's ubiquitous range weed, mesquite, is getting a going-over with the electron microscope in USDA-State studies at Tucson, Ariz.

ARS plant physiologist H. M. Hull is investigating the barrier mesquite leaves present to penetration of herbicides, as part of efforts to determine the most effective and economical means to kill mesquite.

Several reasons for barrier

Absorption of herbicides by leaves depends on the herbicide formulation, temperature and other environmental factors, and the nature of the leaf. Mesquite leaves, like those of other desert plants, have a thick waxy surface (cuticle) and small stomata (openings which permit passage of air and liquid in and out of leaves). The stomata remain tightly closed most of the time. These characteristics help retard water loss through leaves, and by the same token make absorption of herbicides through the leaves difficult.

The powerful magnification of the electron microscope shows the structure of the cuticle as crystal-like wax formations on the surface of epidermal cells, with larger, globular extrusions of wax between cells. These formations make wetting of the leaf by herbicides even more difficult. Changes in wax formation as the leaf matures are now being studied.

The minute scrutiny of cellular and subcellular detail possible with electron microscopy may reveal some of the answers to such questions as why certain herbicides don't penetrate mesquite leaves, why a chemical which does penetrate isn't translocated from leaf to stem to roots, and why the best chemical control worked out so far for Arizona is erratic in its effects from year to year.

Aerial spraying of mesquite with 2, 4, 5–T (2, 4, 5-trichlorophenoxyacetic acid) for 2 consecutive years has given good control (Agr. Res., Oct. 1958, p. 15). Aboveground parts of mesquite plants are killed, and a third treatment, to kill sprouts growing from underground buds, is not necessary for 5 years or more.

But even this method has shown variable results in Arizona. A treatment every few years may be required to maintain control. Repeated sprayings and the amount of herbicide necessary for each treatment may be too costly for dry areas which have poor forage production potential even without weeds.

Previous research, conducted jointly by ARS, the Forest Service, and the Arizona Agricultural Experiment Station, has included tests of new herbicides and various formulations of herbicides, and evaluation of emulsifying agents to increase absorption of herbicides.

Will study climatic factors

Hull and ARS range conservationist F. H. Tschirley hope to pin down the climatic factors affecting herbicide treatments through study of mesquite grown in controlled environment chambers. Outdoor nurseries will be used in investigating the effect of soil moisture level.

These studies, combined with information gathered on what happens to herbicides at the surface of and within the leaf and other plant cells, should give a better chance for development of practical controls. ☆

New and better varieties may come from studies of various genetic characteristics of plants

Combined Effort:

BASIC RESEARCH AND FLAX IMPROVEMENT

A search for improved flax varieties is being combined with basic research in genetics by USDA agronomist V. E. Comstock at the Minnesota Agricultural Experiment Station.

He is investigating the heritability of high oil content, the ability of the oil to dry quickly, seed size, and similar characteristics desirable in a commercial flax variety. His research is also exploring the relationships among different characteristics and the amount of improvement that can result from a selection program. It is hoped that in the course of these studies new and better varieties will emerge, but this is not the main aim of the work.

Flax is grown in this country primarily for its oil, linseed oil. It is a drying oil, that is, one which combines easily with oxygen from the air to form a film. This makes linseed oil valuable for use as a paint base.

Some 1,500 varieties of flax are used in experimental work but only a few are grown commercially here. Five varieties—Marine, B 5128, Redwood, Arny, and Bolley—account for 75 to 80 percent of the flax acreage in the United States. All five are brown-seeded varieties. Some yellow-seeded flax is grown in Texas.

Using both flaxes in studies

Yellow-seeded flax varieties have two characteristics which are desirable in a commercial variety; a high content of oil with a high iodine number. (The iodine number is an index of an oil's drying ability and was originally determined by measuring the amount of iodine the oil would absorb.) However, yellow-seeded varieties tend to be lower yielding, more susceptible to disease, more readily damaged, and lighter in seed weight than the brown-seeded varieties. This accounts for their unpopularity among growers.

Attempts are now being made to breed the desirable characteristics of yellow-seeded flaxes into brown-seeded ones. However, in flax, oil content and ability to dry appear to be related genetically to seed color. In tests carried out by ARS plant breeder J. O. Culbertson and plant pathologist T. Kommendahl of the Minnesota station, lines of flax nearly genetically identical in all but one characteristic, seed color, were grown side by side.

The yellow-seeded line was higher in oil content and iodine number but poorer in other characteristics than the brown-seeded one. This relationship would limit the extent to which desirable characteristics of high oil content and iodine number could be transferred from a yellow-seeded to a brown-seeded variety.

Many oil percentages possible

Research is further complicated by the type of inheritance apparently involved. Oil percentage, for example, is not a simple case of one trait being dominant and another recessive but a condition of quantitative inheritance in which several sets of genes govern the characteristic. Thus, there are many possible oil percentages, depending upon the number of genes present. Generally, progeny are midway between their two parents in oil content.

Through selection and breeding, Comstock raised the oil percentage 1.5 points in one cross and 1.9 points in another in one generation. The crosses were between CI 1455, a yellow-seeded variety, and Redwood, a brown-seeded one, and between CI 1455 and Marine, another brown-

seeded variety. In each case, he chose the top 10 percent of the F_2 (third—and most varied) generation. The improved oil content showed up in the F_3 (fourth) generation.

The fact that high oil content, though associated with yellow color, was transferred to brown-seeded plants was shown by presence of brown-seeded plants with higher oil percentages than their brown-seeded parents.

High iodine number desirable

Iodine number, however, appeared less heritable and more subject to environmental influences than oil content. Though less genetic gain can be made, it is still considered desirable to breed and select for high iodine number. As was the case with oil content, the iodine number shows quantitative inheritance. It is also inherited independently of oil content and, largely, seed size.

Apparently, there is a factor closely associated with the gene determining seed color that sets a minimum iodine number. This was indicated by absence of any yellow-seeded offspring with lower iodine values than their parents and presence of many brown-seeded offspring having values below those of either parent.

Seed weight was found less heritable than either oil content or iodine number and showed a low degree of quantitative inheritance. In addition, heavy seeds tended to have low iodine numbers but high oil contents.

Along with their obvious importance as advances in genetics research, these findings are expected to produce new commercial varieties of flax. If a plant seems to combine much of the high oil quality and quantity of yellow-seeded varieties with the disease resistance and other desirable traits of brown-seeded varieties, field trials will be conducted with an eye to releasing new varieties. ☆

How Salinity Slows

Plant Growth

In saline soils plant growth is stunted and the production of genetic material is impaired. USDA plant physiologist R. H. Nieman believes that salinity slows the growth through its affect on cell division, which in turn may be limited by the supply of genetic material.

Cell division is the first step in leaf initiation and growth. Critical stages in this process come when chromosomes duplicate themselves and the nucleus divides. A substance in the cell called deoxyribonucleic acid (DNA), believed to be the actual carrier of heredity, sets the pattern for duplication of chromosomes. If DNA is unable to reproduce itself, the cell cannot divide and the leaf cannot grow.

Number of cells, more than size of cells, seems to influence leaf size. So, salinity, by slowing down reproduction of DNA and cell division, retards leaf growth. This was shown when, after just a few days in a high-salt solution, plants had smaller leaves and fewer of them than control plants grown in a nonsaline solution.

Through a complicated series of reactions, DNA also influences the production of a very similar substance, ribonucleic acid (RNA). RNA appears to regulate protein synthesis, and protein is vital for growth. Salinity suppresses the production of RNA as well as DNA.

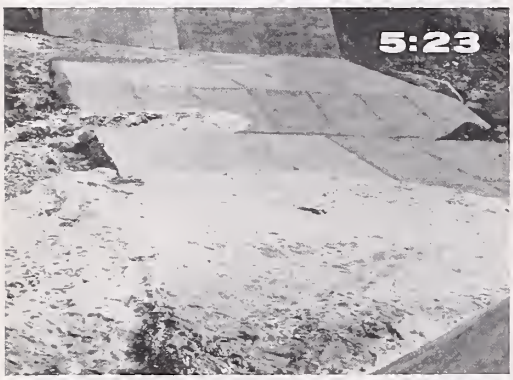
In normal plants the amount of DNA and RNA increases until the plant reaches maturity. Slower growth of salt-stunted plants used in experiments at the U.S. Salinity Laboratory, Riverside, Calif., was accompanied by a slower rate of increase in content of nucleic acids. The ARS scientist believes this is because of impaired synthesis of the acids, not because of an increase in their degradation. In fact, breakdown of RNA was actually suppressed or delayed in the stunted plants.

There appears to be a minimum RNA level per cell that must be maintained in leaves. Any RNA produced above this level apparently can be broken down and translocated to younger leaves. Therefore, if production is slowed, translocation is also suppressed.

DNA content of a leaf, on the other hand, seems to be immobile. Though deoxyribonucleic acid is constantly produced as the leaf enlarges, there is no evidence of its translocation from one leaf to another.

Normal plants also have more DNA and RNA in some leaves than in others. In bean plants, for example, the first trifoliate leaf to emerge has a lower nucleic acid content than later leaves. But in salt-stunted plants, the third and fourth trifoliates have no more DNA and very little more RNA than the first trifoliate.

However, the exact relationship between a saline growing solution and DNA synthesis is still a mystery. Higher osmotic pressure in cells of plants grown on saline cultures may adversely affect some key enzyme systems. Lowered water uptake that seems to result from growing in a saline solution may have something to do with it. ☆



A cloudburst produced this short-lived and dramatic flow at Walnut Gulch. **5:22**—*flow is about 300 feet upstream of flume.* **5:23**—*water enters flume.* **5:26**—*discharge is 3,740 gallons per second (gps.)* **5:30**—*discharge is at peak of 6,358 gps.* **6:58**—*flow is only 561 gps. At a gaging station 5 miles downstream, peak was only 523.6 gps. Large loss is typical.*

Researchers have made a major breakthrough in

MORE EFFICIE

A new flume plus an accurate way to gage runoff from cloudbursts in the Southwest end a barrier to more effective research

■ How much water is lost when cloudbursts cause flash floods in the semiarid Southwest? What happens to the water suddenly filling streambeds—empty about 99 percent of the time—that quickly dry up after the brief and rarely occurring storms?

Losses total millions of gallons a year. This was determined by USDA scientists who developed a new flume to make accurate measurements of the flashy, silt-laden runoff. Although much work remains, they are making headway in finding what happens to the water. Development of the gaging method is considered a major breakthrough that can aid greatly in efforts to learn how to use runoff water more profitably—mainly to produce grass for cattle grazing on some 500,000 square miles.

Hydrographic instruments record the amount of water flowing through flumes across streams. Losses are computed from differences in flow at various points downstream. Use of the unique gaging method means the end of a great barrier to effective runoff studies.

Ranchers are helping by allowing the flumes to be installed on their land. One flume is in the Walnut Gulch watershed, 58 square miles of black gramagrass range near Tombstone, Ariz. Another flume is in the Alamogordo Creek watershed near Santa Rosa, N. Mex

'ts aimed at . . .

T WATER USE

This watershed is 67 square miles of blue gramagrass range. Four smaller watersheds, from 0.9 to 43 square miles, also are under study in the Walnut Gulch area.

After cloudbursts, runoff flows and losses are rather spectacular in the Southwest. For example, about 2 hours after a storm upstream of Walnut Gulch in August 1959, ARS agricultural engineer R. V. Keppel and his associates measured a peak discharge of 6,358 gallons per second, and a total volume of 57 acre feet passing through the flume. At a gaging station 5 miles downstream, the peak was 523.6 gallons per second, and the total volume was 5 acre feet. This loss of more than 10 acre feet per mile is quite typical in the study areas.

Usually the runoff doesn't filter to the permanent ground water table and recharge the supply, because of adverse geological conditions. Apparently much of the water percolates uselessly into shallow aquifers (water-bearing beds of earth, gravel, or porous stone) and is transpired by plants along streams. Getting more information so ways can be developed to put the water to better use is vitally necessary, especially since the need for more water is constantly increasing.

Years of work are necessary to obtain answers

But compiling the information won't be simple. The scientists say it will take several years to obtain needed answers. Cooperating with ARS in various phases of the studies are USDA's Soil Conservation Service, which began the research, and the Arizona and New Mexico Agricultural Experiment Stations.

There's widespread belief that any improvement in kind or amount of vegetation may reduce the already small yield of water from dry ranges. (Estimates are that semiarid brush and grass lands provide only about 6 percent of the water supply in the Southwest.)

Complex relationships require careful study

ARS soil conservationist J. E. Fletcher reports that his experiments indicate increased infiltration of water if ground cover is dense, when conditions are *ideal*. In some instances, however, dense plant cover may decrease infiltration because of wetness due to previous intake. Infiltration and ground cover relationships are complex, he says, so each site must be studied carefully to avoid serious errors.

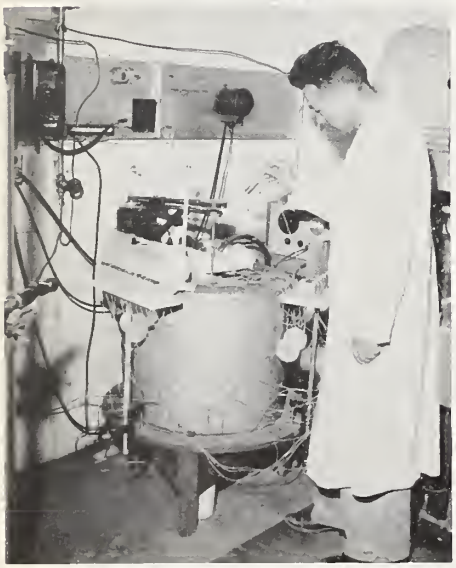
At least 90 percent of the runoff from the Southwest's annual rainfall of 7 to 15 inches usually comes from cloudbursts in July and August. The diameter of each storm is about 1 mile, and several may occur almost simultaneously in one large watershed. Flow rates commonly rise from zero to several thousand gallons per second 15 to 20 minutes after a storm. The streams dry up again in 2 to 3 hours.

Limited storm areas and large stream losses combine to produce a situation in which water yield decreases with increasing size of the watershed. The reason is the low probability of having an entire area covered by a storm of sufficient intensity to form runoff. Also, the larger the watershed, the more extensive the channel system—resulting in more chance for great losses. ☆

Relative humidity of air in soil is accurately gaged by new device

SOIL PSYCHROMETER a new research aid

A drop of water is put in loop of wire on thermocouple at right, and unit is inserted in tube at left. Tube holds the soil sample.



One thermocouple is placed in the instrument by Ogata. A switching system allows testing of any of 20 samples. Tubes are held in water at constant 77° F.

■ Basic research on soil moisture and plant-growth relationships will be aided by a soil psychrometer developed by USDA scientists.

This highly sensitive new instrument is a type of wet-bulb thermometer that accurately measures the relative humidity of air in soil. (The device is capable of measuring differences in relative humidity as small as 1/2000 of 1 percent.) It gives scientists some of the quantitative measurements needed to determine the factors influencing availability of water to plants. As these influences are better understood, scientists hope to develop means of using water more efficiently.

The soil psychrometer was designed by ARS soil scientists L. A. Richards and G. Ogata at the U.S. Salinity Laboratory, Riverside, Calif.

Essentially, the instrument consists of 20 brass sample tubes, specially built thermocouples, seals, and wires connected to meters. Sample tubes are suspended in water that is held at a constant temperature of 77° F. The water is agitated to maintain this temperature in all of the tubes. In this manner, identical temperature conditions are maintained for testing up to 20 soil samples at once.

For testing, a sample is placed in one of the tubes and a pencil-sized depression is formed in the center of the sample. A drop of water is placed in a loop of wire at the end of a thermocouple. Then the unit is inserted into the depression and sealed in the tube.

As the drop of water evaporates, bringing the air in the soil sample to 100 percent relative humidity, the temperature of the water remaining in the drop is reduced. Electricity is generated in the thermocouple by temperature changes as the drop of water evaporates in response to differences in relative humidity between the soil sample and the drop of water.

The electricity is measured to determine the exact relative humidity of the air within the soil sample. (The temperature difference between the soil, 77°, and the water is used to calculate the relative humidity of the air in the soil sample.) A switching system allows any of the 20 soil samples to be tested.

Research shows that most plants will grow if the relative humidity of air in the soil is between 98.91 and 99.83 percent. but will not grow at a relative humidity of 98.90 percent. At this lower humidity, most plants remain alive. but do not grow actively. Plant life usually is not maintained at relative humidities less than 98.90 percent. ☆

WHY HEIGHTS AND WEIGHTS CHANGE

■ The changes in heights and weights of adults in this country over the past 100 years are a result of several factors. USDA researchers point out after a study of data from many sources.

One cause of change is that the proportion of immigrants from different countries has varied. The first settlers were mostly British and northern Europeans who were inclined to be tall. From 1880 on, however, many people of shorter stature came to this country from southern Europe. Their influence showed up in 1917-18 when U.S. soldiers in World War I averaged somewhat shorter than soldiers in the Civil War.

Another factor is that children have been growing taller than their parents—reflecting improvements in medical care and sanitation, increasing abundance of food and better knowledge of nutrition, and a rising economic and social position for much of the population.

The increase in height during the past 60 years for both young men and women averages about 2 inches, according to nutrition specialist Milicent L. Hathaway and statistician Elsie D. Foard of the ARS Institute of Home Economics. That is, men now average 69½ inches tall and women 64½ inches, compared to 67½ inches and 62½ inches before the turn of the century.

College men and women have increased to heights slightly above the general average. For example, young women entering Smith and Vassar have advanced from about 63 inches in the late 1800's to slightly over 65 inches in the 1950's. Their average weight has risen from 118 to 127 pounds. Amherst and Yale male freshmen averaged 67½ inches in the early 1880's and now measure over 70 inches. Their average weight has increased from 135 pounds to about 157 pounds.

The rising percentage of 6-footers among college freshmen is another sign of increased average height of the U.S. population. In 1883 only about 4 percent of young men entering Amherst and Yale were 6 feet and over. But by 1915 the percentage had risen to 10 percent, and in 1956 and 1957 over 30 percent of freshmen classes at both schools measured at least 6 feet.

A table of desirable weights for various heights of men and women has been developed by the researchers. ☆

NEMATODES HAVE ANOTHER ENEMY

■ A new natural enemy of nematodes has been isolated and named by USDA-Louisiana Agricultural Experiment Station nematologist Wray Birchfield.

Catenaria vermicola, a fungus recently found in Louisiana, has been observed in the laboratory to kill nematodes parasitic on hundreds of plants from cotton to kumquats. Under favorable conditions, it will kill plant-parasitic nematodes in the field. In laboratory and greenhouse experiments, the fungus attacked root knot, sting, sheath, dagger, lance, ring, meadow, citrus, and stunt nematodes.

Other species of the genus *Catenaria* also attack nematodes. *C. spherocarpa* kills root knot nematodes of tomatoes and *C. anguillae* is parasitic on a number of nematodes.

Zoospores of the newly-discovered fungus attack nematodes in the soil, forming cysts near the host's body openings—where the protective cuticle is weakest. The fungus then grows a cell tube through the cuticle and into the nematode's body. The tube enlarges and absorbs food. Within the host, the parasite reproduces and breaks the cuticle at new points. Eventually portions of its cuticle are all that remain of the victim.

C. vermicola was first collected on a species of dagger nematode attacking St. Augustine grass around Shreveport, La. Later the fungus was found in sugarcane and rice fields in the same State.

Plants are not believed to be harmed by this fungus. At the same time, however, it shows very little specificity among nematodes.

The ARS researcher is now seeking more information on the living habits of *Catenaria vermicola:* at what temperature it thrives best, its optimum moisture level, etc. He also wants to learn what it actually does in nematode-infested soils and how aggressive it is. His tests are being made in the laboratory and greenhouse. Much additional research will be required before it's possible to determine whether the findings will have practical application under field conditions. ☆

Linked in SOME chickens:

CANCER RESISTANCE AND

Progeny of individual males resisted erythroblastosis, a leukemia-like disease

■ Individual male chickens have transmitted to their progeny complete resistance to an infectious leukemia-like cancer of the bone marrow and blood known as erythroblastosis.

This was possible even though some of the female mates were genetic carriers of susceptible genes.

Studies by geneticist N. F. Waters of USDA's Regional Poultry Research Laboratory, East Lansing, Mich., suggest that one pair of autosomal dominant genes may control resistance to erythroblastosis. This may be accomplished in the same way that a pair of genes controls visible traits in progeny obtained from a specific male and female. Final evidence for this awaits further testing.

Strangely enough, however, this resistance was transmitted only to birds of the same line. When resistant males were crossed with birds of another line also resistant, the resistance disappeared.

Inbred White Leghorns used

Waters conducted genetic studies on the occurrence of artificially induced erythroblastosis in highly inbred lines of White Leghorns. The lines have been maintained at the laboratory for 20 years without introduction of outside stock.

Erythroblastosis is part of the avian leukosis complex—related cancerous diseases of poultry attacking different parts of the body. Natural occurrence of erythroblastosis is quite low, indicating that it isn't transmitted readily from chicken to chicken as is lymphomatosis—one of the commonest forms of the avian leukosis complex and the most important economically. Under some conditions, however, virus strains causing erythroblastosis will also cause a high incidence of lymphomatosis. This puzzling behavior is only one of many aspects of the avian leukosis complex not completely understood.

Mortality differences great

There were marked differences in mortality from erythroblastosis between the inbred lines of inoculated chickens. Two of the lines—9 and 15—were especially high in resistance. An analysis of matings within and between these lines backs up the belief that resistance to this blood cancer is genetic in nature.

Four males from line 15 were mated with a number of females from the same line. All of the progeny were inoculated with erythroblastosis. Progeny from three of the matings showed a high mortality rate, with those from the third mating showing the highest death rate—39 percent. But *none* of the progeny from the fourth mating died from the disease. The third and fourth matings were repeated with the same results.

Then the males used in the third and fourth matings were reversed. The male of the fourth mating, which produced resistant progeny, was mated to the females of the third mating, which produced the largest number of susceptible progeny. *All the resulting chicks were completely resistant to erythroblastosis.*

The male used in the third mating was mated with the females of the fourth mating. These females, which previously produced resistant offspring, now produced chicks that were highly susceptible to erythroblastosis. Similar results were obtained in line 9 matings.

The resistant line 15 male used in the fourth mating was obviously capable of transmitting to his offspring complete resistance to the disease. And the male of the third mating, mated to the same females, transmitted genes capable of expressing susceptibility to erythroblastosis. The two males that gave these divergent responses were full brothers.

Many deaths in some crosses

But, when a resistant male from line 9 was mated to 10 females from line 15, nearly three-quarters of the resulting 222 progeny died after inoculation with erythroblastosis.

The same results were obtained with visceral lymphomatosis. A single male from line 9 mated to 7 fe-

males of the same line produced 126 offspring, none of which died from tumors after inoculation. But when a resistant male from line 9 was crossed with females from line 15, over three-quarters of the inoculated 222 offspring died with tumors.

Resistance in other crosses

In a series of crosses between inbred lines it was found that all progeny from crosses between a line 7 resistant male and line 15 resistant females and from a line 15 resistant male and line 7 resistant females were resistant to both erythroblastosis and visceral lymphomatosis. However, whenever males or females from line 9 were involved in crosses between completely resistant lines, high mortality occurred in the progeny.

There's no satisfactory explanation as yet for this unique behavior. Waters and his associates are conducting considerable research at East Lansing to understand why resistance is inherited in certain lines but not in others.

Studies also showed that some of the dams each produced five or more progeny that remained free of erythroblastosis, even though the sires with which they were mated produced affected progeny when mated to other dams. This suggests that the female parent can also influence genetic resistance to erythroblastosis. ☆

Crowded hens are poor layers, nervous, and cannibalistic.

Egg production is higher, and mortality is lower when you . . .

DON'T CROWD LAYING HENS

■ Birds of a feather may well flock together, but it sure doesn't help egg production any. USDA tests show that the more hens you put in a cage the less those hens will lay.

Put five in a 24-inch cage and you have a bunch of excited, nervous, noisy, and irritable ladies. Cannibalism is aggravated in response to the irritability, mortality goes up, and egg production down.

Put a hen alone in an 8- by 10-inch cage, and she cackles contentedly. She's serene and her happiness reflects in high egg production.

This isn't startling news, but it's suprising to learn how much mortality goes up and production down in response to crowding.

It's fairly common practice for commercial egg producers in Arizona—and the practice is growing in the Southwest—to house layers at least five to a cage. Even larger cages with more birds are anticipated in the future. Major reason for this trend, of course, is that larger cages with more birds require less housekeeping and less labor.

But if egg production drops off seriously—and research indicates that it does—then it may be more practical to separate layers into smaller or individual units. The cost of extra labor and handling would be offset by greater egg production and lower mortality.

In recent tests, ARS poultry husbandman R. W. Lowe of the Southwest Poultry Experiment Station, Glendale, Ariz., put one bird each into 8-inch and 10-inch wire cages. He also put two birds each into 12-inch cages, and five birds each into 24-inch cages. All birds were in production when housed at 5 months of age.

Birds living five to a 24-inch cage averaged 208 eggs each for the 336-day test period, and mortality averaged 38 percent.

Hens doubling up in 12-inch quarters did a little better. They averaged 226 eggs for the same period, and mortality was 16 percent.

And the birds living in their own private cages—8 or 10 inches square—did best of all. Those in the 10-inch cages averaged 232 eggs for the test period, with a mortality rate of 13 percent. Birds in the 8-inch cages averaged 231 eggs and had a mortality rate of 12 percent. Feed conversion was the same for birds in all cages.

In another test, pullets weren't laying when caged at about 16 weeks of age. They were caged about 8 weeks and laying about 4 weeks before one death from cannibalism. When caged about 16 weeks and laying about 12 weeks, cannibalism had killed over 20 percent. ☆

Now we can study

NIACIN BOUND IN CORN

■ A method for separating from corn the substance in which the vitamin niacin is bound—so it's not available for animal nutrition—has been developed by USDA.

The research makes the niacin-binding substance available for further study. Details of its composition and the separation are among the first reported.

Why animals can't utilize niacin in corn is a question for which researchers have long sought an answer. Recently, scientists in England and elsewhere found that alkali treatment releases niacin for animal nutrition, but how and why still aren't known.

The ARS work at Peoria, Ill., may help answer these questions and explain the exact relationship between pellagra, a disease caused by niacin deficiency, and high-corn diets. Analytical chemist D. D. Christianson, biochemist J. S. Wall, and chemist R. J. Dimler of the Northern utilization division conducted the research.

They discovered that bound niacin is easily extracted from ground corn (by ethyl alcohol solutions) but isn't very soluble in water. Bound niacin, they found, is concentrated in corn gluten, a water-insoluble, protein-rich fraction. (This fraction is obtained during milling of corn for starch.) Ion-exchange resins were used to purify the niacin-binding substance and to obtain a concentration 1,000 times greater than in whole corn.

The substance also contains glucose and amino acids. By partially degrading the niacin material with dilute acids, the researchers obtained water-soluble fragments with niacin. Paper chromatography revealed that the niacin is closely associated with an amino acid. They are presently determining the nature of the chemical linkage of the bound niacin.

Poor utilization of niacin in corn has been recognized by nutritionists for many years. In 1944, scientists at the University of Wisconsin suggested that niacin in corn is chemically bound so it's unusuable by animals. Researchers at the University of Cambridge, England, during the past several years established that niacin-containing compounds of corn and other cereals must be treated with alkali or otherwise decomposed before animals can use it.

Although alkali treatment makes niacin in corn nutritionally available, the treatment has never been used as a commercial process for obtaining the vitamin. Niacin is easily obtainable from other sources, and many foods and feeds in the U.S. are enriched with it. ☆

TWO NEW CHERRY VARIETIES

■ Trees of two new sweet cherry varieties, Chinook and Ranier, should be available from nurserymen in the fall of 1961. Budwood for increase has been released cooperatively by USDA and the Washington Agricultural Experiment Stations.

Chinook produces large, attractive, heart-shaped to rounded cherries whose mahogany-colored skin remains glossy at maturity. The flesh is medium to dark red, firm, and uniformly colored.

Ranier, a light-colored cherry, produces large, egg-shaped fruit that ripens 3 to 7 days earlier than Napoleon. The new variety has yellow skin with a slight pink cast. The flesh is clear and contains colorless juice.

Ranier is extremely winter hardy and blooms and produces foliage about the same time as Bing. Chinook blooms a day or two before Bing, develops foliage 3 to 4 days earlier, and produces ripe fruit 4 to 10 days earlier than Bing. Also, Chinook is more winter hardy than Bing, but not as hardy as Van.

Tree of both varieties are vigorous, upright-spreading, and proved virus-free in indexing tests at Prosser, Wash. These varieties are suited to fresh market sales and processing. Although neither is self-pollinating—pollen is needed from nearby trees such as Bing, Van, or Sam—both are good pollinators of Bing.

The new cherry varieties may be suited to many areas of general sweet cherry production, but ARS scientists advise trial plantings before large-scale growth. ☆

Gelatinous fibers split logs

Tension splitting in hickory and other hardwood logs immediately after cutting is due to a high proportion of gelatinous fibers in the wood, USDA foresters conclude.

This finding came from a study in which the Southeastern Forest Experiment Station, Asheville, N.C., and Forest Products Laboratory, Madison, Wis., cooperated with the South Carolina Agricultural Experiment Station at Clemson.

In woods that split severely, gelatinous fibers are distributed in relatively

large amounts over the entire cross section and in almost all the annual rings at all levels except at the stump. In those that don't split, the gelatinous fibers—if present—are confined to a specific area, usually the upper side of a leaning trunk. It is not known what causes gelatinous fiber formation.

Splits appear first at the butt end of a tree immediately after it is felled and continue to develop as the tree is cut into logs.

Splitting interferes with utilization of the logs, sometimes making it impossible to saw them into lumber. At present there is no known treatment which can be used on trees or logs to prevent tension splits in the ends of logs.

New sugarcane for Georgia

A new sugarcane variety superior for sirup production in southwest Georgia has been released cooperatively by USDA, the Georgia Agricultural Experiment Station, and the Cairo Cane Growers' League.

Developed by ARS in cooperation with the League, C.P. 52–48 has consistently given higher sirup yields per acre than presently grown varieties. It is superior to them in early germination, development of stands in plant cane (first year's crop) and stubble crops (following crops from same planting), and lodging resistance. It is equal to the popular C.P. 29–116 in percentage of juice extracted, Brix (total sugars, starches, and minerals in solution), clarification, and sirup quality.

Stalks of C.P. 52–48 are well adapted for mechanized harvesting and milling because of their straight growth. Its long, drooping leaves provide shade early and help control weeds. Mosaic disease has not been found in C.P. 52–48 in Georgia, nor has damage from red rot been important.

Growers may apply for seedcane of the new variety from Foundation Seeds, Inc., 3–7 Hoke Smith Annex, Athens, Ga., or the Cairo Cane Growers' League at the U.S. Sugar Crops Field Station, Cairo, Ga.

Salad dressing being improved

A salad dressing that can be frozen and stored is being developed by three USDA scientists.

The basic dressing, a mixture of safflower oil, waxy-rice flour, and fresh egg yolks, remains stable at temperatures as low as 10° F. The oil and water do not separate upon thawing. Researchers are working now to develop a dressing that is stable at 0° F., the temperature at which frozen foods should be held.

This is being done at the ARS Western utilization division laboratory, Albany, Calif., by food technologist Helen L. Hanson and chemists Lorraine L. Fletcher and L. Kline.

Such a dressing could be used in salads, sandwiches, and other foods frozen and stored for use later.

Stops sprouts in stored potatoes

Potatoes can be stored at 55° F. for up to a year *without* sprouting—if the tubers are dipped in or sprayed with a 0.25 or 0.5 percent solution of the chemical CIPC.

This use of the chemical has been accepted for registration by USDA. A residue tolerance for CIPC [isopropyl N-(3-chlorophenyl) carbamate] used commercially on potatoes was established recently by the Food and Drug Administration.

P. C. Marth, ARS plant physiologist at Beltsville, Md., discovered the potential of CIPC as a potato sprout inhibitor while testing the compound on different plants. He and Agricultural Marketing Service plant physiologist P. H. Heinze tested CIPC on several varieties of potatoes.

Sprouting lowers potato quality, shortens storage life, and causes shriveling because moisture is lost through sprouts. When correctly applied, CIPC prevents deterioration of potato appearance and does not affect taste, the studies showed.

Potatoes stored at temperatures below 50° F. do not make good chips. (Such temperatures are maintained in

potato warehouses to check sprouting of untreated potatoes, but are not effective after 3 to 4 months.) At temperatures under 50° F., the starch in the potatoes changes to sugar,

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and chips made from potatoes so stored turn dark brown when processed.

Storage method for alfalfa pollen

Alfalfa pollen for future use in breeding research can now be stored 6 months or longer, according to USDA agronomist C. H. Hanson.

The pollen is vacuum dried and sealed in glass vials about the size of a king-sized cigarette. Pollen viability remained high after storage 183 days at room temperature or 0° F.

Working at the Agricultural Research Center, Beltsville, Md., the ARS scientist tested three pollen storage methods: (1) in cork-stoppered vials kept at 0° F.; (2) vacuum-dried and sealed in vials held at 0° F.; and (3) vacuum-dried and sealed in vials kept at room temperature. (The glass vials were sealed by heating and fusing the open end.)

Pollen in cork-stoppered vials was viable after 132 days, but began to deteriorate after 183 days (the long-

est period used). Vacuum drying, sealing, and storing at low temperatures appears to be the most promising method for prolonging the life of alfalfa pollen. Low temperatures may not be necessary during short periods of storage. Normally, alfalfa pollen stays viable 4 to 10 days without special handling.

Stored pollen is particularly useful in crossbreeding when parent plants flower at different times. Storage also eliminates the necessity of having mature plants as a pollen source at breeding time and makes possible the exchange of germ plasm by plant breeders. Glass vials are easy to store and ship.

A chemical for improving felts

An inexpensive and nontoxic chemical may be the key to a new and better method of producing wool felts.

Boiling wool in dimethyl sulfoxide causes the fibers to supercontract (shrink). Applied to pressed felts, the chemical can make them denser without the mechanical compression usually needed, say USDA chemists N. H. Koenig and R. A. O'Connell.

Experimental fabrics shrank 28 percent when boiled in 221° F. dimethyl sulfoxide for an hour, in tests at the ARS Western utilization division laboratory, Albany, Calif. This was the result of an actual contraction of the fibers. They didn't just move closer together.

The treatment still has drawbacks to be eliminated. Fibers are weakened somewhat and are less resistant to acids and alkalis. This would be undesirable in some felts.

Halogeton also menace to grass

Halogeton, range weed poisonous to sheep and cattle (AGR. RES., April 1957, p. 11: March 1960, p. 14), is also a serious menace to native range grasses, according to State and USDA scientists.

Studies by plant ecologist F. E. Kinsinger of the Nevada Agricultural Experiment Station and ARS range conservationist R. E. Eckert indicate that forage grasses may not be able to grow successfully on soils where halogeton has grown several years.

The scientists found that salt-containing residues of halogeton alter the chemical properties of the soil and greatly reduce seed germination and emergence of certain grasses.

Kinsinger and Eckert, in laboratory tests, added a mulch of halogeton to the surface of three types of soil which had supported desert vegetation, and allowed water to leach through the mulch and soil. The leachate was reapplied, and seeds of various range grasses were planted.

Halogeton mulch added at the rate of 47½ tons per acre reduced emergence to 45 percent for tall wheatgrass, less than 25 percent for Russian wildrye and crested wheatgrass, and less than 7 percent for intermediate and pubescent wheatgrasses, Indian ricegrass, bulbous bluegrass, and *Bromus brevis*.

Under field conditions, the cumulative effect of halogeton residues over a period of years could equal or surpass the rate used in the studies.

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